DOCUMENT RESUME

ED 357 891 PS 021 506

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TITLE The Cognitive Consequences of Collaboration: Why Ask How?
PUB DATE 26 Mar 93
NOTE 11p.; Slightly revised version of a paper presented at the Biennial Meeting of the Society for Research in Child Development (60th, New Orleans, LA, March 25-28, 1993).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Development; *Cognitive Processes; *Cooperation; Problem Solving; *Research Methodology; *Research Problems; Young Children
IDENTIFIERS Collaborative Inquiry

ABSTRACT

The outcomes of collaboration provide an incomplete and potentially misleading picture of cognitive change, one that is clarified by examining the collaborative processes themselves. Results from a study illustrate the dangers of focusing solely on the consequences of collaboration and emphasize why the analysis of collaborative processes is essential. In the study, 180 children between 6 and 8 years of age were given a pretest in which they predicted the movement of a mathematical balance beam in 14 problems. Children were randomly assigned to one of four conditions: no partner, equally competent partner, more competent partner, and less competent partner. Some children received feedback and the others received no feedback. All children took 2 individual posttests, 4 days after and again 2 weeks after the problem solving. When viewed from the perspective of the outcomes of collaboration, results indicated that those who received feedback improved more than those who did not. However, when considered from the perspective of collaborative processes, results revealed that, far from being the main determinant of cognitive change, feedback was mediated by the nature of the collaboration between partners. It is clear that an approach that relies on independent variables may be less useful in understanding the cognitive consequences of collaboration than an approach that questions how collaboration impacts cognitive development. (MM)

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ED357891

The cognitive consequences of collaboration: Why ask how?

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Slightly revised version of a paper presented as part of a symposium "The processes linking peer collaboration and cognitive change" (Chair, Saba Ayman-Nolley), at the biennial meetings of the Society for Research in Child Development, New Orleans, March 26, 1993. The authors gratefully acknowledge the contribution of Susan Bjorge, who collected the data, and Lara Schmitz and Masharel Mangum, who assisted in the coding of these data. Most of all, our thanks go to the children, teachers, and principals of Ensign and Rosecrest Elementary Schools, Salt Lake City.

PS 021506

Running head: WHY ASK HOW?

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The cognitive consequences of collaboration: Why ask how?
Jonathan Tudge and Paul Winterhoff

In this presentation we argue that the outcomes of collaboration (the effects of pairing and feedback on cognitive change at posttest) provide an incomplete and potentially misleading picture of cognitive change, one that is clarified by examining the collaborative processes themselves. As Vygotsky argued: "We need to concentrate not on the product of development but on the very processes by which higher forms [of mental functioning] are established" (Vygotsky, 1978, p. 64).

Over the last decade increasing attention has been paid to peer collaboration in the course of solving problems, focusing on the extent to which children can benefit from such collaboration (Azmitia & Perlmutter, 1989; Garton, 1992; Tudge & Rogoff, 1989). Some researchers have contrasted independent performance resulting from child-child collaboration with performance following adult-child collaboration (Ellis & Rogoff, 1982, 1986; Gauvain & Rogoff, 1989; McClane, 1987; Radziszewska & Rogoff, 1988, 1991), whereas other researchers have focused solely on peer collaborations (Ames & Murray, 1982; Azmitia, 1988; Bearison, Magzaman, & Filardo, 1986; Brownell, 1990; Doise & Mugny, 1984; Forman, 1987; Forman & McPhail, in press; Koester & Bueche, 1980; Murray, 1982; Perlmutter, Behrend, Kuo, & Muller, 1989; Perret-Clermont, 1980; Rubtsov, 1991; Tudge, 1989, 1992).

The results of these various studies are not altogether consistent. Typically, children who had collaborated with adults performed better when later tested alone than children who had collaborated with peers, even when those peers had been trained to solve the problem more easily (Ellis & Rogoff, 1982, 1986; Radziszewska & Rogoff, 1988, 1991). When focusing solely on peer collaboration, researchers have typically found that children who came to a problem with different perspectives were most likely to benefit from collaboration (Doise & Mugny, 1984; Murray, 1982; Perret-Clermont, 1980). However, there are clear exceptions to these typical findings. In some cases children do not benefit more from working with an adult (Gauvain & Rogoff, 1989) or can be led to regress when the adult provides incorrect information (Rosenthal & Zimmerman, 1972, 1978; Zimmerman & Lanaro, 1974). Sometimes children benefit from working with another child whose thinking is at the same level, when there is no difference of perspectives (Perret-Clermont, 1980) but sometimes do not (Russell, 1982). Although most researchers find socio-cognitive conflict to be beneficial, regression of the more competent partner has been reported (Tudge, 1989, 1992).

Why are such discrepancies found? One of the reasons, we believe, stems from the fact that scholars have been far more interested in the consequences of collaboration than in the processes of collaboration themselves. This is particularly true for those whose research has been set in the Piagetian tradition that focuses on socio-cognitive conflict. The typical research design is a pretest-treatment-posttest design, the task typically chosen from the conservation paradigm. Thus children are tested to ascertain their status as conservers or non-conservers (for example on a conservation of liquid task). During the treatment phase a non-conserver is asked to collaborate with one or more conserving partners. For the posttest, the children are retested individually, to discover the extent of change. Little or no attention is paid to the collaborative processes themselves.

By contrast, scholars whose work is set within the Vygotskian tradition are more likely to focus on collaborative processes. This is particularly true of Wertsch and his colleagues (Wertsch, 1979, 1985; Wertsch & Hickmann, 1987; Wertsch, Minick, & Arns, 1984) and of Forman and her colleagues (Forman, 1987; Forman & Cazden, 1985; Forman & McPhail, in press). However, these scholars have been more successful illustrating the processes of collaboration (primarily through transcript analysis) than in demonstrating the consequences of collaboration (in the sense of pretest-posttest individual changes in performance). This is perhaps not surprising, as statistical

demonstrations of group differences require relatively large numbers in each group, and time-consuming analyses of process become increasingly costly as the number of participants increases.

Nonetheless, whether one's research is set within a Piagetian or a Vygotskian framework, there is no theoretical reason to suppose that simply requiring two partners to work together on a problem is likely to lead to cognitive development for either of them. As Piaget argued, peer discussion on some topic on which they disagree ("socio-cognitive conflict" as Piagetian scholars have termed it) may lead to development, but only to the extent to which the participants work together to solve the problem and achieve resolution or coordination. Piaget argued that "it is precisely by a constant interchange of thought with others that we are able to decentralize ourselves...to coordinate internally relations deriving from different viewpoints" (1950, p. 164), and believed that the development of rule-based thinking stemmed from "mutual agreement and cooperation" (1932, p. 362).

Commentators who have taken seriously Piaget's thinking about the role that the social world plays in children's cognitive development have drawn clear connections between the Piagetian concept of equilibration and intersubjectivity (Bearison, in press; Chapman, 1988, 1992). As Youniss and Damon (1992) argued:

> As children rely on each other for feedback about ideas, they would come to know one another's views because they were parties to a mutual construction. Thus mutual understanding would produce solidarity in the very ways children come to interpret reality. Not only would experience be shared, but the meaning of the experience would be the product of joint construction (p. 273).

The same is true for Vygotsky, who argued that interaction with a more competent other could be beneficial but only if in the course of collaboration a zone of proximal development was created by the participants:

> We propose that an essential feature of learning is that it creates the zone of proximal development; that is, learning awakens a variety of developmental processes that are able to operate only when the child is interacting with people in his environment and in collaboration with his peers (Vygotsky, 1978, p. 90).

The importance of creating such a zone and solving problems in the course of what Rogoff (1990) has termed "guided participation" is that the child may appropriate what has been learned in collaboration. What the child can do independently has then become fused with what the child could do with help during collaboration. As Vygotsky pointed out when discussing the results of collaboration between a teacher and a child:

> [The child] continues to act in collaboration, even though the teacher is not standing near him....This help--this aspect of collaboration--is invisibly present. It is contained in what looks from the outside like the child's independent solution of the problem (Vygotsky, 1987, p. 216).

For the remainder of this presentation, we would like to illustrate the dangers of focusing solely on the consequences of collaboration, and why it is that analysis of the processes of collaboration are so essential. The data to be presented are part of a larger study of joint problem solving.

Methodology

a) Pretest, in which 180 children (6- to 8-year olds, predominantly white, heterogeneous in terms of SES) predicted the movement of a mathematical balance beam (Siegler, 1981) in 14 problems. Responses to the problems determined which of 5 different "rules" each child used.

b) Treatment, in which "target" children were randomly designated and assigned to one of four "pairings": no partner (n = 35), equally competent partner (n = 24), more competent partner (n = 24), and less competent partner (n = 19). Target children and their partners worked together on 8 problems, 4 of a type solvable by the rule the target used at pretest, 4 by a rule one higher. Some children (n = 60) received feedback (supports holding the beam in place were removed); the

remaining children (n = 42) received no feedback.

c) Two individual posttests, four days and two weeks later.

Results

Outcomes of collaboration. Essentially, no differences were found for age of child, gender, or type of partner, and therefore we shall focus here on the presence of a partner (as opposed to working alone) and feedback. Only target children are included in these analyses (to ensure independence of the units of analysis), and children who used Rule 5 were dropped, as they were effectively at ceiling and would not be expected to improve. ANCOVA was run on the posttest-pretest difference scores (pretest rule serving as the covariate). These analyses revealed that feedback was significant at both the first and second posttest (Fs (1, 81) = 40.36 and 43.41, ps < .0001 respectively), that pairing was not significant at either posttest (ps > .2), but that the interaction of feedback by partner was significant at both times (Fs (1, 81) = 10.29 and 20.74, ps < .002 and .0001 respectively). (Each of these effects are independent of those of the remaining terms of the model.)

As Table 1 and Figure 1 reveal, while it is clear that children who received feedback improved more than those who did not, the biggest differences in outcomes were for children who worked without a partner. Those who received feedback improved the most at both posttests whereas those who did not receive feedback improved only slightly (and non-significantly) at the first posttest and actually declined at the second posttest. By contrast, children who worked with a partner and who received feedback only improved a little more than those who did not receive feedback. These results, however, refer solely to the outcome data--the results of collaboration.

Insert Table 1 and Figure 1 about here

Processes of collaboration. The focus of the presentation, however, is not on the outcomes but on the processes whereby collaboration leads to cognitive change. An examination of the dyadic justifications and discussions reveal that feedback, far from being the main determinant of cognitive change, was in fact mediated by the nature of the collaboration between partners.

Vygotskian theory (Vygotsky 1978, 1987) predicts that two factors are important components of collaborative problem solving. The first, that the problem should be within the less competent member's zone of proximal development, was addressed by providing problems at a rule one level above the target child's pretest rule. The second is that intersubjectivity (shared meaning arrived at in the course of creating a zone of proximal development) should be attained. Videotapes of the treatment session were coded, to assess the extent to which shared meaning was attained by the participants. The variable intersubjectivity was created by examining the extent to which dyad members reached shared meaning, as marked by the dyad members' predictions, justifications, and discussions (particularly focusing on whether the children referred to number of weights alone, distance from the fulcrum alone, or number and distance simultaneously in support of their ideas). Intersubjectivity was coded when the target adopted the rule that the partner had used (determined by the target's predictions and justifications), assuming first that this rule was different from the one that the child had used in the pretest and second that the target showed evidence of accepting the partner's reasoning (rather than simply agreeing as a way of ending the discussion, for example). This shared meaning could be either at a higher or lower level than the target child had used at the time of the pretest.

To examine intersubjectivity, those who worked alone were dropped from the analyses. The initial analysis simply included feedback in the model, with pretest rule entered as the covariate. The results seemed to confirm what had been found in the earlier analysis--that feedback had a significant effect at the time of the first posttest (F (1, 58) = 7.51, $p < .01$) and tended in that direction at the time of the second (F (1, 58) = 2.86, $p < .10$). This model

accounted for 36% of the variance at the time of the first posttest, and 28% at the time of the second. To reiterate, the data seemed to confirm the impact of feedback.

However, when intersubjectivity (the attaining of joint understanding in the course of discussion) was added to the model, the results were quite different. A good deal more of the variance was explained by this model (50% and 33% at the two posttests, compared to 36% and 28%). Intersubjectivity, as a main effect, was significant at the first posttest (Fs (1, 56) = 13.25, $p < .001$) and tended in that direction at the second posttest (F (1, 56) = 3.03, $p < .10$). The interaction of feedback and intersubjectivity was also significant at the time of the first posttest (F (1, 56) = 4.11, $p < .05$), but not at the second ($p > .10$). However, feedback, with intersubjectivity added to the model, exerted no independent significant effect at either posttest (ps > .8). Thus, as Table 2 and Figure 2 indicate, the attaining of intersubjectivity carried virtually the entire weight in terms of the outcome data.

Insert Table 2 and Figure 2 about here

It is thus clear that a simple reliance on packaged independent variables may be less useful in allowing an understanding of the cognitive consequences of collaboration than an approach that seeks to answer the question: "How does collaboration impact development?" Specifically, the ways in which children work together, in particular their willingness to work together to arrive at some shared understanding of the problem allow us to understand why it is that some children benefit from collaboration while others do not. As both Piaget and Vygotsky argued, simply requiring that two individuals work together does not ensure that they will arrive at a coordination of perspectives or intersubjective understanding.

References

Ames, G. J., & Murray, F. B. (1982). When two wrongs make a right: Promoting cognitive change by social conflict. Developmental Psychology, 18, 894-897.

Azmitia, M. (1988). Peer interaction and problem-solving: When are two heads better than one? Child Development, 59, 87-96.

Azmitia, M., & Perlmutter, M. (1989). Social influences on children's cognition: State of the art and future directions. In H. W. Reese (Ed.), Advances in child development and behavior, Vol. 22 (pp. 89-144). New York: Academic Press.

Bearison, D. J. (in press). Interactional contexts of cognitive development. Piagetian approaches to sociogenesis. In L. Tolchinsky (Ed.), Culture, cognition, and schooling. Norwood, NJ: Ablex.

Bearison, D. J., Magzaman, S., & Filardo, E. K. (1986). Socio-cognitive conflict and cognitive growth in young children. Merrill-Palmer Quarterly, 32, 51-72.

Brownell, C. A. (1990). Peer social skills in toddlers: Competencies and constraints illustrated by same-age and mixed-age interaction. Child Development, 61, 838-848.

Chapman, M. (1988). Constructive evolution: Origins and development of Piaget's thought. Cambridge: Cambridge University Press.

Chapman, M. (1992). Equilibration and the dialectics of organization. In H. Beilin & P. B. Pufall (Eds.), Piaget's theory: Prospects and possibilities (pp. 39-59). Hillsdale, NJ: Erlbaum.

Doise, W., & Mugny, G. (1984). The social development of the intellect. Oxford: Pergamon Press.

Ellis, S., & Rogoff, B. (1982). The strategies and efficacy of child vs. adult teachers. Child Development, 53, 730-735.

Ellis, S., & Rogoff, B. (1986). Problem solving in children's management of instruction. In E. C. Mueller & C. R. Cooper (Eds.), Process and outcome in peer relationships (pp. 301-325). Orlando, FL: Academic Press.

Forman, E. A. (1987). Learning through peer interaction: A Vygotskian perspective. The Genetic Epistemologist, 15, 6-15.

Forman, E. A., & Cazden, C. B. (1985). Exploring Vygotskian perspectives in education: The cognitive value of peer interaction. In J. V. Wertsch (Eds.), Culture, communication and cognition: Vygotskian perspectives (pp. 323-347). Cambridge: Cambridge University Press.

Forman, E. A., & McPhail, J. (in press). A Vygotskian perspective on children's collaborative problem-solving activities. In E. A. Forman, N. Minick, & C. A. Stone (Eds.), Education and mind: The integration of institutional, social, and developmental processes. New York: Oxford University Press.

Garton, A. F. (1992). Social interaction and the development of language and cognition. Hillsdale, NJ: Erlbaum.

Gauvain, M., & Rogoff, B. (1989). Collaborative problem solving and children's planning skills. Developmental Psychology, 29, 139-151.

Koester, L. S., & Bueche, N. A. (1980). Preschoolers as teachers: Where children are seen but not heard. Child Study Journal, 10 (2), 107-118.

McLane, J. B. (1987). Interaction, context, and the zone of proximal development. In M. Hickmann (Ed.), Social and functional approachers to Language and thought (pp. 267-285). Orlando, FL: Academic Press.

Murray, F. B. (1982). Teaching through social conflict. Contemporary Educational Psychology, 7, 257-271.

Perlmutter, M., Behrend, S., Kuo, F., & Muller, A. (1989). Social influence on children's problem solving at a computer. Developmental Psychology, 25, 744-754.

Perret-Clermont, A.-N. (1980). Social interaction and cognitive development in children. London: Academic Press.

Piaget, J. (1932). The moral judgement of the child. New York: Harcourt Brace.

Piaget, J. (1950). The origins of intelligence in children. New York: Norton. (Original work published in 1936.)

Piaget, J. (1959). The language and thought of the child (3rd. Ed.). London: Routledge & Kegan Paul. (Original work published in 1923 and 1948.)

Radziszewska, B., & Rogoff, B. (1988). Influence of adult and peer collaborators on children's planning skills. Developmental Psychology, 24, 840-848.

Radziszewska, B., & Rogoff, B. (1991). Children's guided participation in planning imaginary errands with skilled adult or peer partners. Developmental Psychology, 27, 381-389.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. Oxford: Oxford University Press.

Rosenthal, T. L., & Zimmerman, B. J. (1972). Modeling by exemplification and instruction in training conservation. Developmental Psychology, 6, 392-401.

Rosenthal, T. L., & Zimmerman, B. J. (1978). Social learning and cognition. New York: Academic Press.

Rubtsov, V. V. (1991). Learning in children: Organization and development of cooperative actions. New York: Nova.

Russell, J. (1982). Cognitive conflict, transmission and justification: Conservation attainment through dyadic interaction. Journal of Genetic Psychology, 142, 283-297.

Siegler, R. S. (1981). Developmental sequences within and between concepts. Monographs of the Society for Research in Child Development, 62(2, Serial No. 189).

Tudge, J. R. H. (1989). When collaboration leads to regression: Some negative consequences of socio-cognitive conflict. European Journal of Social Psychology, 19, 123-138.

Tudge, J. R. H. (1992). Processes and consequence of peer collaboration: A Vygotskian analysis. Child Development, 63, 1364-1379.

Tudge, J. R. H., & Rogoff, B. (1989). Peer influences on cognitive development: Piagetian and Vygotskian perspectives. In M. H. Bornstein & J. S. Bruner (Eds.), Interaction in human development (pp. 17-40). Hillsdale, NJ: Erlbaum.

Vygotsky, L. S. (1978). Mind in society. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1987). The collected works of L. S. Vygotsky: Vol. 1, Problems of general psychology. New York: Plenum.

Wertsch, J. V. (1979). From social interaction to higher psychological processes: A clarification and application of Vygotsky's theory. Human Development, 22, 1-22.

Wertsch, J. V. (1985). Vygotsky and the social formation of mind. Cambridge, MA: Harvard University Press.

Wertsch, J. V., & Hickmann, M. (1987). A microgenetic analysis of problem-solving in social interaction. In M. Hickmann (Ed.), Social and functional approaches to language and thought (pp. 251-266). Orlando, FL: Academic Press.

Wertsch, J. V., Minick, N., & Arns, F. (1984). The creation of context in joint problem solving: A cross-cultural study. In B. Rogoff & J. Lave (Eds.), Everyday cognition: The social context of the development of everyday cognitive skills (pp. 151-171). Cambridge, MA: Harvard University Press.

Youniss, J., & Damon, W. (1992). Social construction in Piaget's theory. In H. Beilin & P. B. Pufall (Eds.), Piaget's theory: Prospects and possibilities (pp. 267-286). Hillsdale, NJ: Erlbaum.

Zimmerman, B. J., & Lanaro, P. (1974). Acquiring and retaining conservation through modeling and reversibility cues. Merrill-Palmer Quarterly, 20, 145-161.

Table 1. The impact of pairing and feedback on changes from pretest (0 = no change from pretest, SD in parentheses)

	N	Δ Post 1	Δ Post 2
Feedback			
With partner	38	1.05[d] (1.16)	0.74[c] (1.45)
No partner	15	1.80[d] (0.86)	1.87[d] (1.06)
Total	53	1.26[d] (1.13)	1.06[d] (1.43)
No feedback			
With partner	23	0.70[b] (1.18)	0.57[a] (1.24)
No partner	10	0.20 (0.63)	-0.50 (0.97)
Total	33	0.55[b] (1.06)	0.24 (1.25)

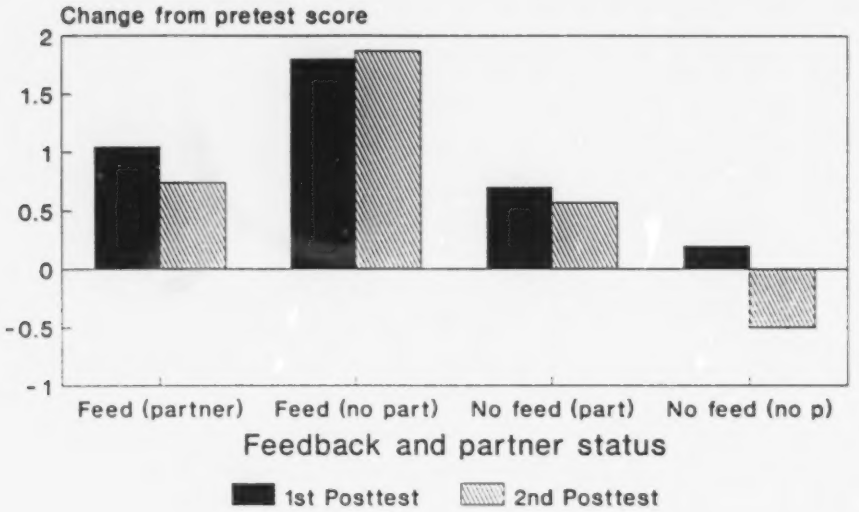
[a] $p < .05$, [b] $p < .01$, [c] $p < .005$, [d] $p < .001$

Table 2. The impact of attaining intersubjective understanding on changes from pretest (0 = no change from pretest, SD in parentheses)

	N	Δ Post 1	Δ Post 2
Intersubjectivity			
With feedback	34	1.29[d] (0.94)	0.94[d] (1.37)
No feedback	11	1.27[b] (1.27)	1.00[a] (1.34)
Total	45	1.29[d]	0.96[d]
No intersubjectivity			
With feedback	4	-1.00[+] (0.82)	-1.00[+] (0.82)
No feedback	12	0.17 (0.83)	0.17 (1.03)
Total	16	-0.13 (0.96)	-0.13 (1.09)

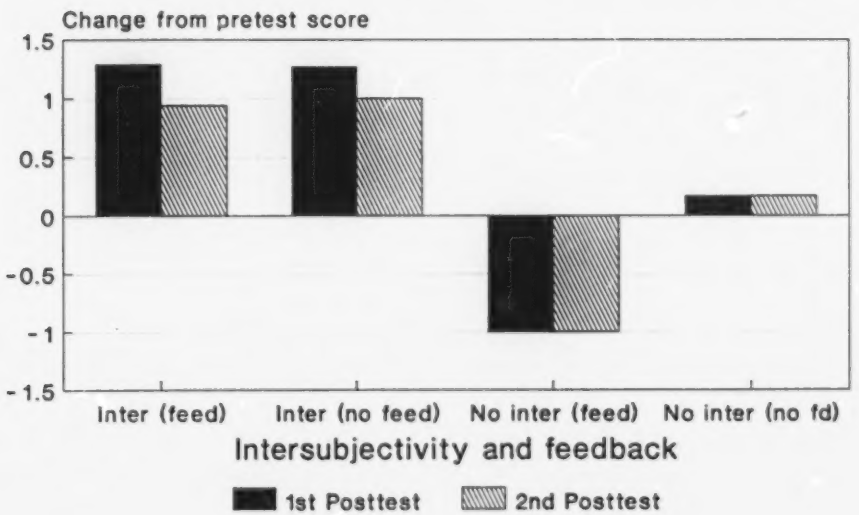
[+] $p < .10$, [a] $p < .05$, [b] $p < .01$, [c] $p < .005$, [d] $p < .001$

1: Impact of Feedback, Partner
(Changes at 1st and 2nd posttest)



0 = no change from pretest

2: Impact of Feedback, Intersub
(Changes at 1st and 2nd posttest)



0 = no change from pretest